Extended Corresponding States Method for Type-I Mixtures Containing Water

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The paper presents an application of the one-fluid extended corresponding states method to the calculation of the thermodynamic surface of type-I water containing mixtures. As example of non-azeotropic and azeotropic mixtures the ammonia-water and ethanol-water systems were chosen, respectively. The following pure-fluid equations of state were selected for the analyzed compounds: Haar-Gallagher for ammonia, Pruß-Wagner for water and cubic equation of state reported in TRC Thermodynamic Tables for ethanol. During the calculation of the pure component equivalent substance reducing ratios (or scaling factors), a method based on the mapping defined by the extended corresponding states algorithm and two-dimensional interpolation was used. Also, to test the numerical behavior of the solution different pure fluids were set as the reference one (ea. ammonia, water, ethanol). The estimation of the binary interaction parameters was performed using the general case of the least squares method: the case when all observations and unknowns are subject to uncertainty and are adjusted simultaneously with the constraint equations. A special interest was paid to the estimation of the phase boundary of the mixtures (bubble and dew surfaces, up to critical curves). The final quality of estimation was assessed using available data on the thermophysical properties of analyzed mixtures.